APPLICATION OF RAMAN SPECTROSCOPY TO THE INVESTIGATION OF SHOCKED ROCK AND ASSOCIATED LICHEN FROM THE HAUGHTON CRATER.

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Abstract: This contribution reports on the applications of Raman spectroscopy to the analysis of lichen and cyanobacteria found growing on shocked rock.

The Haughton Crater in the High Arctic was formed by a meteorite impact 23 million years ago. The resulting impact affected everything in the surrounding area, including the ground rock and life living nearby [1]. All life was wiped out and shockwaves went through the ground. The shockwaves left the rock with an increase in size and number of pores (shocked rock). The translucency of the rock also increased [2].

Craters are interesting for studying with regards to the emergence of life [1] and also as many of the other planets in the Solar System are also heavily cratered, they have implications for exobiology. Panspermia is one consideration, as any life that survived the journey through the vacuum of space and then through Earth's atmosphere could grow and thrive on Earth. Water can also be brought to Earth by large meteorites or comets. This water could help support the reestablishment of microorganisms. The resulting impact may heat local groundwater [1], creating a warm, wet environment for bacterial life to develop.

Mars is a planet that has an abundance of craters and many of these are known to have had lakes in them [3]. These craters will have characteristics similar to the few that have been located on Earth. This makes Haughton Crater a very good analogue to examine with regards to exobiology.

Raman spectroscopy has been selected as the chosen method of analysis as it has been proved to be appropriate for both organic and inorganic matter. It can successfully differentiate between similar minerals and also the biological components of lichens and cyanobacteria. Raman spectroscopy can be used *in situ* and generally requires very little or no sample preparation. It is hoped that a future Mars mission will include a miniature Raman instrument as part of its analytical payload.

Three spectrometers were used in the analysis: a Bruker IFS66 FT, a Renishaw spectrometer with lines at 488, 515, 633 and 785 nm and a portable 'Raman in a suitcase' (RIAS) operating at 785 nm. An assessment of the RIAS has will be made to see how it compares to a laboratory-based instrument.

The samples are taken from an area of Haughton Crater known as Trinity Rock. The rock is a shocked gneiss of a granitic origin. Lichen and cyanobacteria can live within and on the shocked rock as there is a greater pore density. This means the living organisms can move into the pores and crevices, which provide protection from a harsh environment. Shocked rock is also more translucent to sunlight can reach further through the rock allowing photosynthesis. A sample of a lichenic mat has also been analysed (see Figure 1).

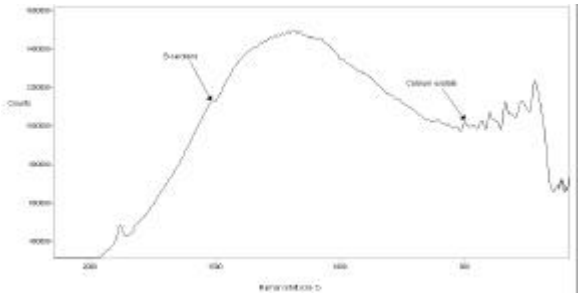

Figure 1: spectrum of the lichenic map with position of some biomarker peaks shown.

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